

<sup>1</sup> Surgical Anatomy of Coeliac Trunk Variations an Autopsy Series  
<sup>2</sup> of 40 Dissections

<sup>3</sup> Dr. S.Saritha,<sup>1</sup>

<sup>4</sup> 1

<sup>5</sup> Received: 11 December 2013 Accepted: 2 January 2014 Published: 15 January 2014

<sup>6</sup>

---

<sup>7</sup> **Abstract**

<sup>8</sup> In modern surgical, radiological and transplantation procedures an anatomic vascular  
<sup>9</sup> variations is of greater importance. The coeliac axis arterial patterns are of importance in  
<sup>10</sup> planning all surgical performances mainly liver transplantation and radiological procedures in  
<sup>11</sup> the upper abdomen. This is to avoid surgical mistakes which may lead to serious consequences  
<sup>12</sup> to the patient and also medico legal implications. The celiac orcoeliacartery, is also known as  
<sup>13</sup> the coeliac trunk (coeliac axis), or truncus coeliakus. It is the first major branch of the  
<sup>14</sup> abdominal aorta. The coeliac artery supplies oxygenated blood to the liver stomach  
<sup>15</sup> abdominalesophagus spleen and the superior half of both the duodenum and the pancreas.  
<sup>16</sup> These structures are derived from the embryonic foregut. The coeliac artery is an essential  
<sup>17</sup> source of blood, since the interconnections with the other major arteries of the gut are not  
<sup>18</sup> sufficient to sustain adequate perfusion.

<sup>19</sup>

---

<sup>20</sup> **Index terms**— coeliac trunk (CT), commonhepatic artery (CHA), left gastric artery (LGA); splenic artery  
<sup>21</sup> (SA), superior mesenteric artery (SMA), inferior phrenic art

<sup>22</sup> **1 Introduction**

<sup>23</sup> The coeliac trunk is the first ventral branch of the abdominal aorta and it supplies the supracolic organs. The Coeliac  
<sup>24</sup> trunk arises at the level of T12/L1 vertebral bodies just below the Aortic hiatus. It is 1.5-2 cms long and passes  
<sup>25</sup> almost horizontally forwards and slightly to the right above the pancreas. (1).

<sup>26</sup> According to standard anatomical textbook descriptions, the coeliac trunk and its branches supplies the  
<sup>27</sup> gastrointestinal tract from the lower 1/3 rd of the esophagus to middle of 2 nd part of the duodenum and all  
<sup>28</sup> derived adenae (liver, biliary tree, spleen, pancreas, greater and lesser omentum).

<sup>29</sup> When there is one vascular variation, there is a high chance of multiple variations. The arterial architecture  
<sup>30</sup> is important in a patient undergoing surgery in this area or it may lead to a risk of an error in committing lethal  
<sup>31</sup> complications. Variations of these arteries and their relationship to the surrounding structures are of particular  
<sup>32</sup> importance from a surgical perspective. Incidence and variation in the branches of the CT requires specialized  
<sup>33</sup> preoperative diagnostic knowledge.

<sup>34</sup> An anatomical variation of the coeliac trunk and hepatic arteries has considerable importance in liver  
<sup>35</sup> transplants, hepatobiliary manipulations, laparoscopic abdominal surgery, radiological abdominal interventions  
<sup>36</sup> and penetrating injuries to the abdomen. The aim of the present study was to highlight the additional branches  
<sup>37</sup> arising from the CT and discuss their topography, which may be important for surgeons operating in upper  
<sup>38</sup> abdominal regions. Presence of additional arteries may provide collateral circulation which is essential during  
<sup>39</sup> transplant surgeries. We looked at these vascular systems in routine cadaveric dissections. .

40 **2 II.**

41 **3 Materials and Methods and Observations**

42 The branching patterns of the Coeliac trunk was done on 40 embalmed cadavers (34 males and 6 females) which  
43 were used during routine dissection by undergraduate I MBBS students from the Department of Anatomy for  
44 a period of 3 years. The abdomen region was dissected out carefully for Coeliac trunk and their branches by  
45 retracting the stomach and the small intestine. Each and every branch was traced from the origin to the  
46 termination. Specimens with topographical derangements were excluded from the study. The variations in the  
47 branching pattern of the coeliac artery were observed in four male cadavers and the rest of the cadavers showed  
48 the normal branching pattern.

49 **4 Results**

50 In the present study the trifurcation of the coeliac trunk into usual three branches, the LGA, the CHA, and the  
51 SA was observed in all the cadavers except four.

52 The clinically relevant variations of the coeliac trunk in those four male cadavers were as follows:

53 **5 Discussion**

54 Arterial vascularization of the gastrointestinal system is provided by anterior branches at three different levels  
55 of the abdominal aorta (the coeliac trunk and the superior and inferior mesenteric arteries). Differences arising  
56 during several developmental stages in the embryonic process lead to a range of variations in these vascular  
57 structures. Anatomical variations involving the visceral arteries are common and knowledge of them becomes  
58 important in patients undergoing diagnostic angiography for gastrointestinal bleeding or prior procedures such  
59 as laparoscopy and laparotomy or any major surgeries of upper abdomen. Therefore the variation concerning  
60 the CT should be kept in mind during both surgical and non-surgical evaluations. The anatomical variation of  
61 the CT or its branches makes it vulnerable to iatrogenic surgery. It enables to distinguish features which merit  
62 further investigations.

63 Data derived from past research on cadavers and living persons has shown a plethora of variations. About  
64 15% of the individuals display significant variations from the typical branching pattern of the CT. The CT  
65 anatomy in routine examination showed that it can divide into 2-6 branches. Variations in the branches of the  
66 CT are most commonly reported once and many authors have reported different variation patterns. Additional  
67 branches of the CT other than its normal branches are referred to as collaterals. 3 The pattern of branching of  
68 the CT were observed to vary from classical trifurcation, to abnormal trifurcation, bifurcation, quadrifurcation  
69 , pentafurcation and even hexafurcation of the trunk. The additional branches of the trunk included the inferior  
70 phrenic artery, gastro duodenal artery, middle colic artery, dorsal pancreatic artery, Volume XIV Issue I Version  
71 I Year ( ) 2014 I jejunal or duodenal branch. Clinically relevant variations of the coeliac trunk were noted in many  
72 cases. 4 Two cadavers showed (Fig- ?? & 4) additional branches i.e. GDA & IPA on right and on left side. The  
73 coeliac trunk is widest ventral branch of the abdominal aorta and its unusual embryological development can  
74 lead to very rare about 1%-2.7% of all anomalies involving the coeliac axis, which arose at the level of L1.  
75 ?? The Coeliacomesentric trunk is often fortuitous during autopsy dissections or can be accidentally detected by  
76 angiography or abdominal computed topography. The scanning without knowledge of the arterial architecture  
77 of the patient in this critical area can lead to surgical risk of error and lethal complications. The injury of the  
78 Coeliacomesentric trunk can involve ischemia to both foregut and midgut derivatives. 6 A rare case of absence of  
79 the Coeliac trunk. In such cases the LGA, the SA, the CHA and the SMA arteries arising independently from the  
80 abdominal aorta. 7 In some cases all the four branches arise from common trunk means quadrifurcation of the  
81 coeliac trunk. The cadaver in the Fig- ?? The present study showed type 5 (Fig- 1) and type 6 (Fig- ??

82 **6 ) of Adachi & Michel et al classification**

83 The Lipshutz gave a detailed account of the CT based on the mode of origin and distribution of gastric, splenic  
84 and the hepatic arteries and classified into 4 types. 9 Type I: (75% cases) The coeliac axis was the common trunk  
85 of origin for the LGA, the SA and the CHA.

86 Type II: (15% cases) The HA and the SA arose from the CT but the LGA had varied origin, either from the  
87 HA or directly from the Abdominal aorta. Type III: (6% cases) The LGA the HA took origin from the CT but  
88 the SA was a separate branch from the Abdominal aorta.

89 Type IV: The coeliac axis was the trunk of origin for the LGA and the SA and the CHA occurred as separate  
90 branch from the aorta.

91 The present study 36 cadavers showed with type I (76%) of Lipshutz classification. This is the normal pattern  
92 of branching of CT seen in 31 males and 5 females.

93 The variations of the CT are common but asymptomatic. They may become important during surgeries and  
94 radiological procedures. The CT in addition to LGA, SA and CHA may also sometimes give accessory right  
95 hepatic artery and both inferior phrenic arteries. These findings before operation is necessary to avoid post-  
96 operative complications and for better accurate radiological interpretations. 10 The bilateral origin of inferior  
97 phrenic arteries from the CT was observed in cadaver (Fig- ??) presenting pentafurcation of CT. Similar findings

98 was observed by Petrella et al (34.84%) 10 Knowledge about this variation avoids unintentional sectioning of  
99 small caliber arteries during the coeliac artery depression in compression syndrome of the CT by median arcuate  
100 ligament.

101 Classic branching of the coeliac artery into LGA, SA and CHA is seen in approximately 70%. Variations are  
102 present in 30% . In general any of the three coeliac branches may arise independently from the Aorta or SMA  
103 or coeliac artery may give rise to other branches. 11 Extra coeliac origin of its branches: 12 1) From aorta-LGA  
104 2-3%, SA-<1% and CHA-2%.

105 2) From SMA-LGA-extremely rare, SA <1% and CHA-2%. VI.

## 106 7 Conclusions

107 The cadaveric findings of the coeliac artery variations and their subtypes in our study is fundamental, that could  
108 help to minimize complications related to upper abdominal surgeries This article builds on previous reports  
109 and re-emphasizes the importance of coeliac artery variations for useful planning of surgical and radiological  
110 procedures of the upper abdomen, including laparoscopic operations of the biliary tract The vascular variations  
111 are usually asymptomatic. The background knowledge for the different vascular patterns of the coeliac axis is vital  
112 and may become important in patients who undergo coeliacography for gastro-intestinal bleeding, coeliac axis  
113 compression syndrome, and prior to operative procedures or transcatheter therapy and for chemoembolization of  
the pancreas. <sup>1 2</sup>

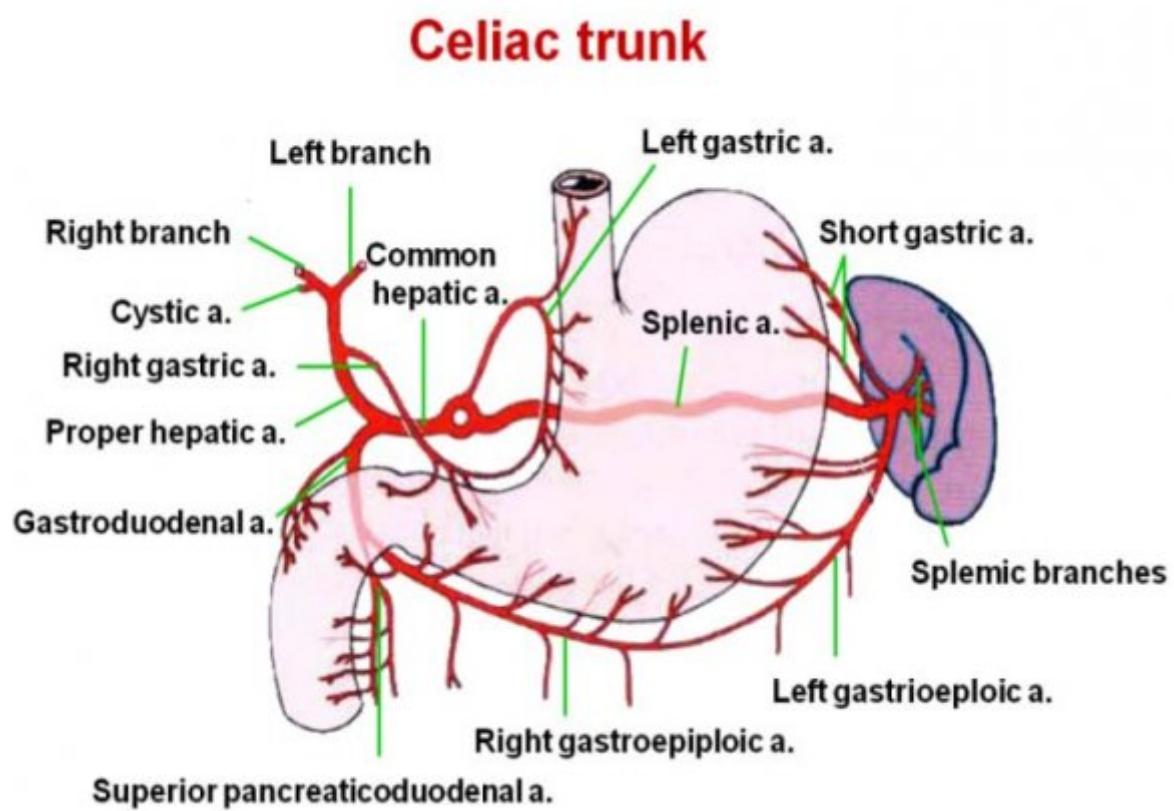


Figure 1: T

114

<sup>1</sup>© 2014 Global Journals Inc. (US)

<sup>2</sup>)(Tandler-1904) 14 thevariations in the splanchnic vessels as suggested by Tandler. The ventral



---

## **BIFURCATION OF COELIAC TRUNK INTO LGA and SA. CHA from SMA-Fig 1**

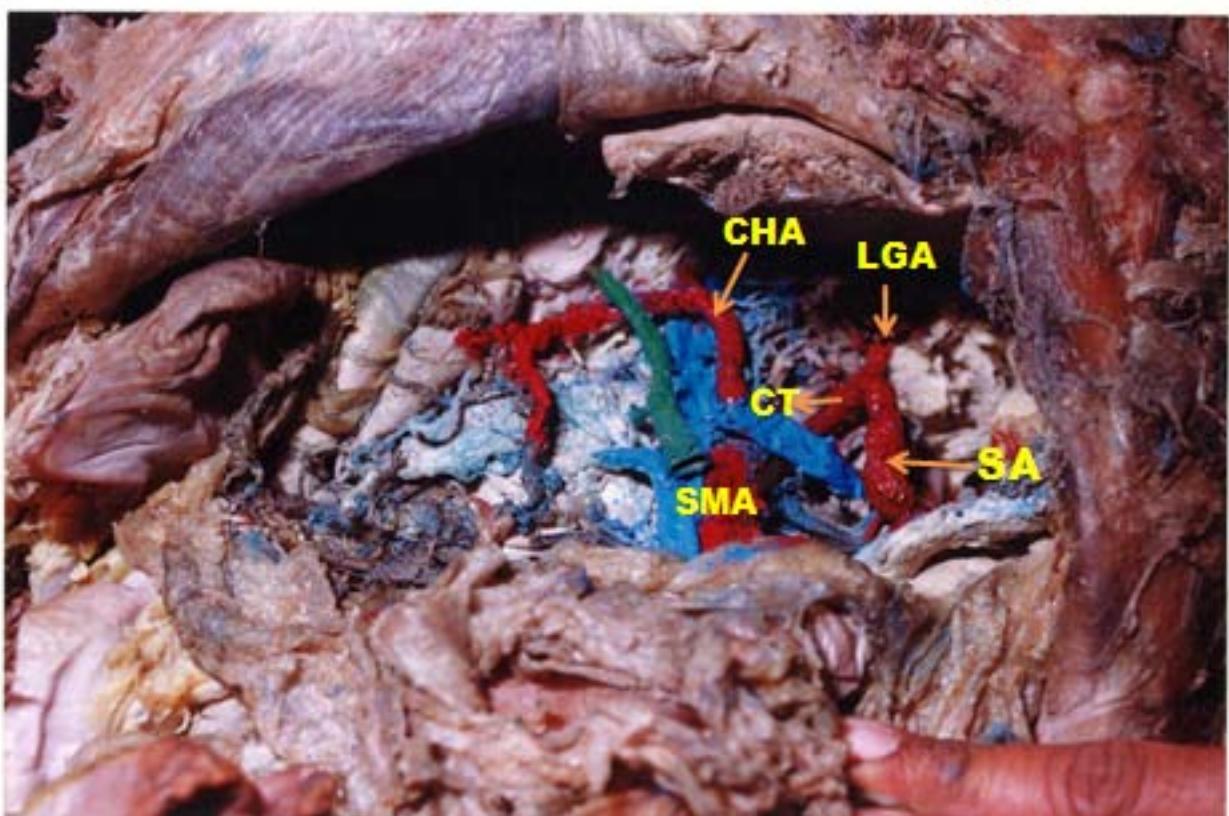
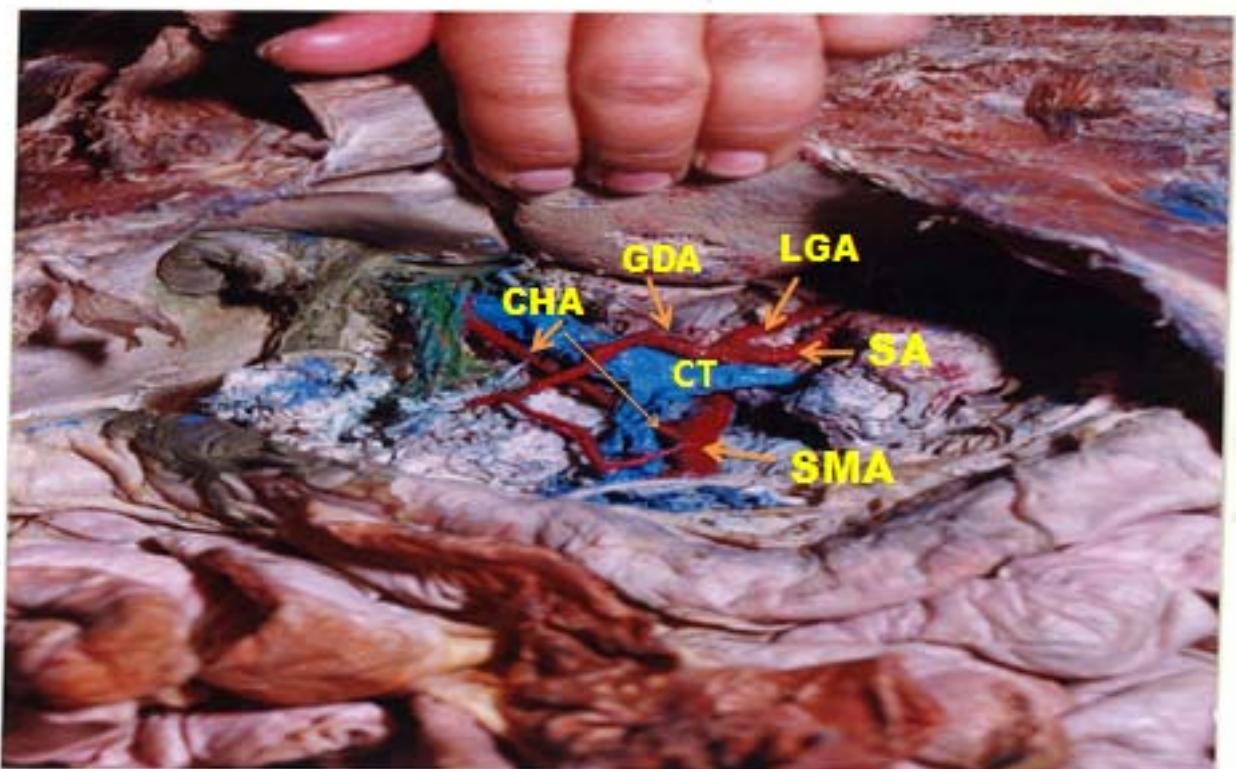


Figure 3:

**ABNORMAL TRIFURCATION OF THE COELIAC TRUNK INTO -LGA,SA & GDA.CHA from SMA. Fig-2**

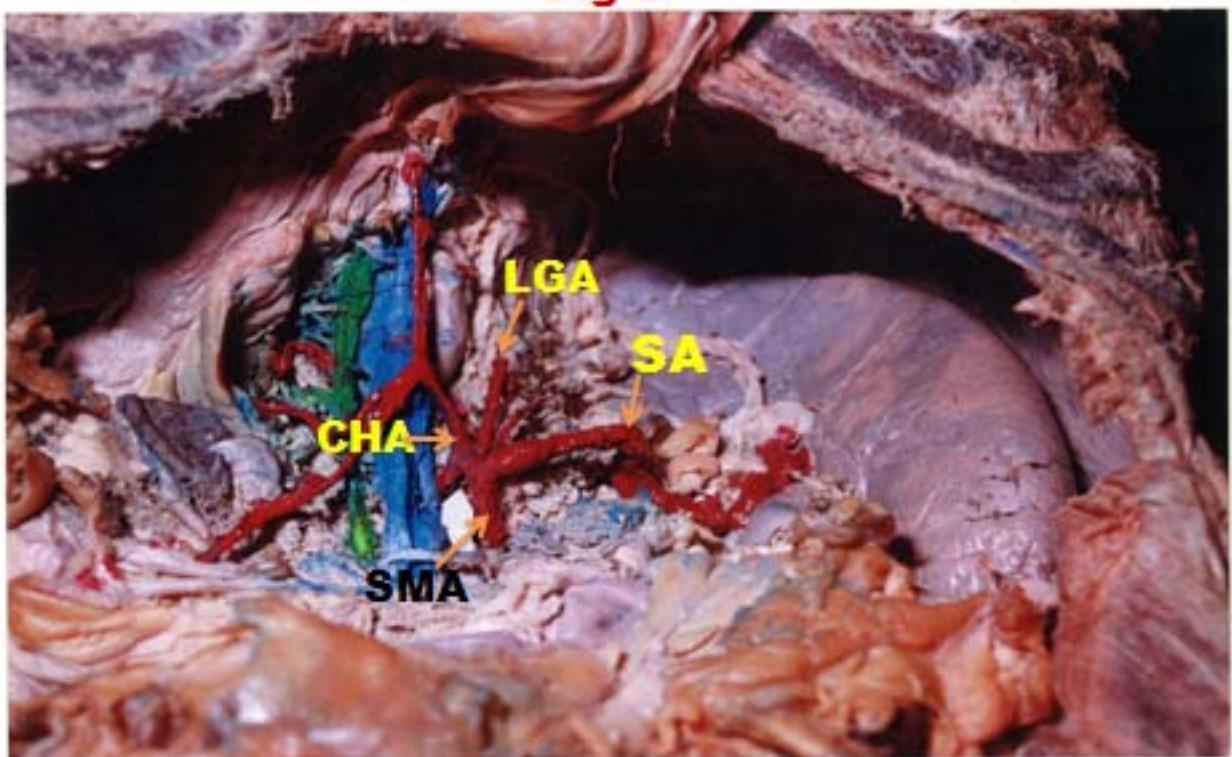


1

Figure 4: 1 :

---

**QUADRIFURCATION OF THE COELIAC TRUNK**  
**SMA, LGA, SA and CHA(coeliaco-mesenteric axis)**  
**Fig-3**



336

Figure 5: 3 )Type 3 :Type 6 :

**PENTAFURCATION OF THE COELIAC TRUNK  
RIPA,LIPA,LGA,SA& CHA. Fig-4**

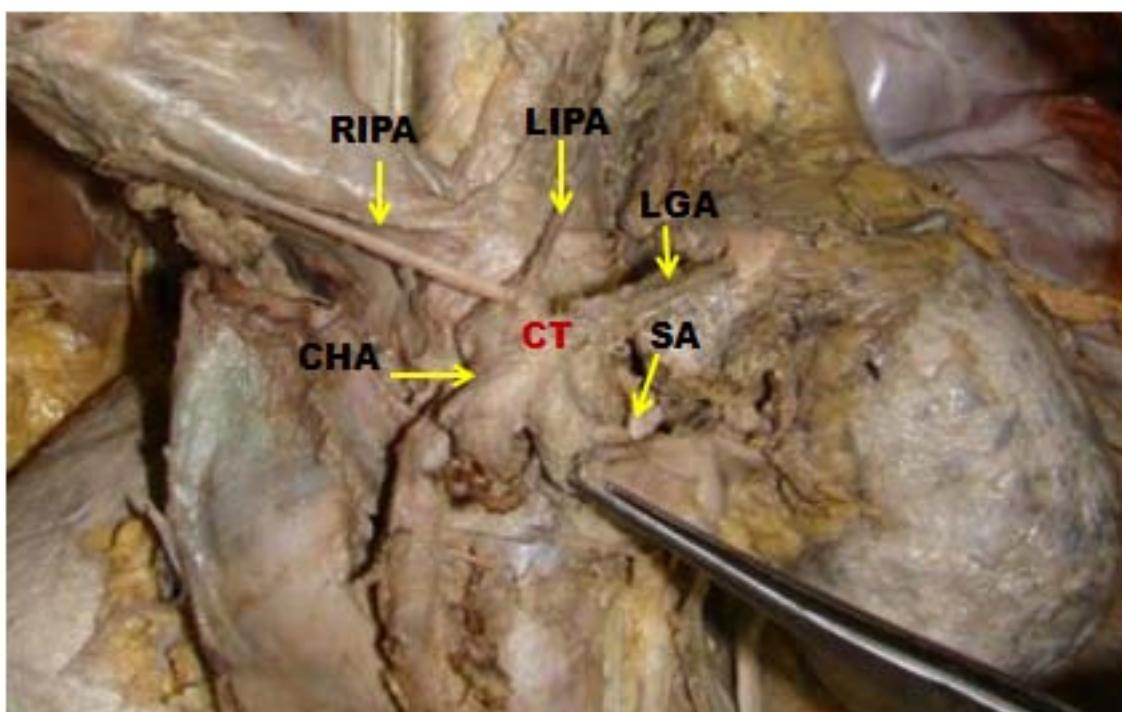


Figure 6:

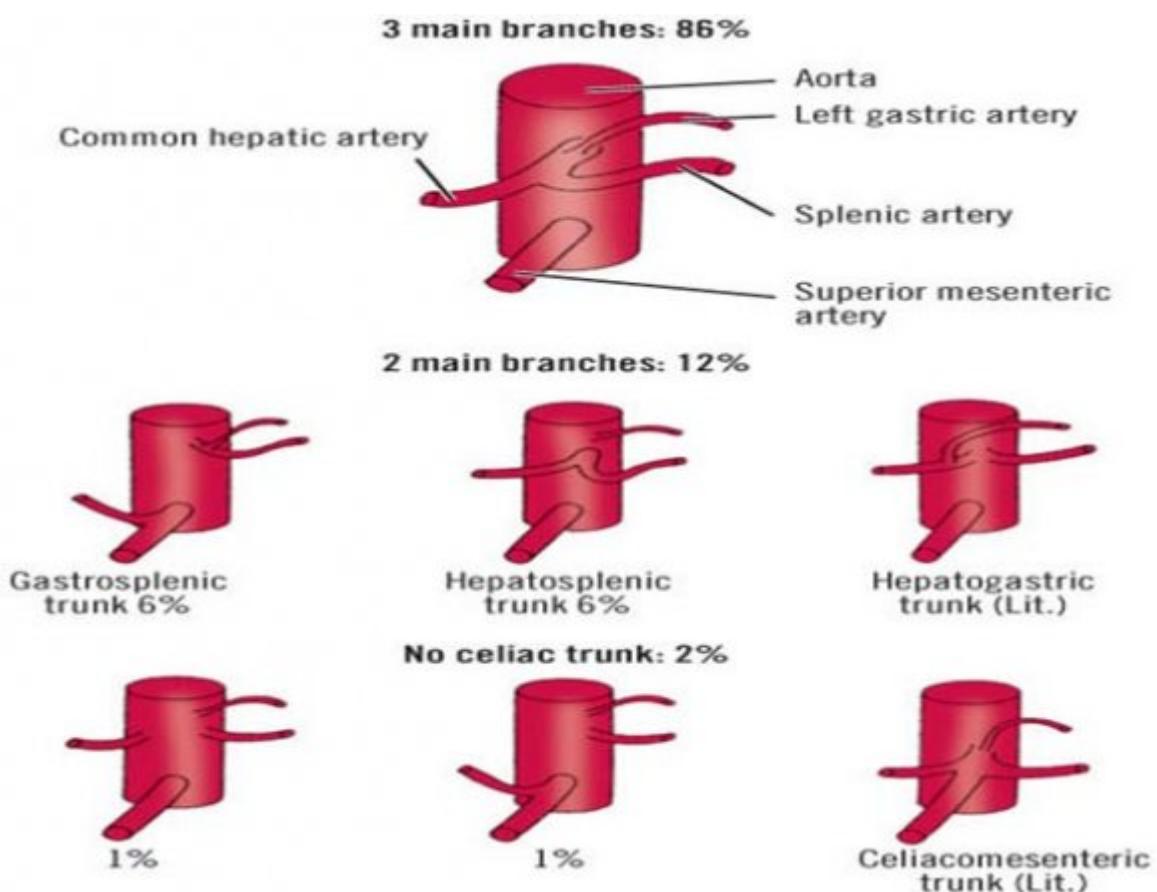


Figure 7:

## **7 CONCLUSIONS**

---

115 longitudinal anastomoses which connect the four roots of the ventral splanchnic vessels and the central two  
116 disappear. The 1<sup>st</sup> and 4<sup>th</sup> roots remain and are connected via anastomoses. The CHA, LGA and SA usually  
117 originate from the 1<sup>st</sup> root and the SMA from the 4<sup>th</sup> root. The ventral longitudinal anastomosis usually  
118 separates between these two roots. If this separation occurs at a higher level, any one of the coeliac branches can  
119 be displaced to the SMA.

120 2) The origin of collaterals, particularly the IPA from the CT can be explained on the basis of Murakami  
121 Typological theory in 1995-1998. 15 According to him he proposed coeliaco-mesenteric system develops from six  
122 sets of paired left and right vessels (sub phrenic, upper, middle and lower ventricular and upper and lower intestinal  
123 arteries). These arteries are modified during the later stages of the fetal development. Collaterals may either  
124 persist or disappear between the longitudinal channels which may be a factor to cause variable anatomy of the  
125 coeliac axis.

126 3) Other factors have been suggested to the variability of the coeliac axis include the rotation of the midgut  
127 and physiological herniation and leftward migration of the spleen and hemodynamic changes in the abdominal  
128 viscera. (Reuter & Redman-1977) 16

129 [Adachi ()] , B Adachi . *Das Arteriensystem der Japaner* 1928. Japanese. 2. Verlag der Kaiserlich-Japanischen  
130 Universität zu Kyoto

131 [Yamaki et al. (1995)] , K Yamaki , N Tanaka , T Matsushima , K Miyazaki , M Yoshizuka . *Ann Anat* 1995  
132 Jan. 177 (1) p. .

133 [Cicekcibasi et al. ()] 'A rare variation of the coeliac trunk'. A E Cicekcibasi , I Uysal , M Seker , I Tuncer , M  
134 Buyukmcu , A Salbacak . *Annals of Anatomy* 2005. 187 p. .

135 [Chitra ()] 'Clinically relevant variations of the coeliac trunk'. R Chitra . *Singapore Med Journal* 2010. 51 (3) p.  
136 5.

137 [Coeliacartery | Radiology Reference Article | Radiopaedia.org radiopaedia.org/articles/coeliacartery]  
138 *Coeliacartery | Radiology Reference Article | Radiopaedia.org radiopaedia.org/articles/coeliacartery*,

139 [Cavdar et al. ()] 'Coeliacomesentric trunk'. S Cavdar , U Sehirli , B Pekin . *Clin Anat* 1997. 10 (4) p. .

140 [Wang et al. ()] 'Coeliacomesentric trunk with concurrent aneurysm: report of a case'. Y Wang , P Chen , N  
141 Shen , J T Yang , J H Chen , W G Zhang . *Surg Today* 2010. 40 p. .

142 [Murakami et al. ()] 'Coexistence of rare arteries in the human Celiacomesenteric system'. T Murakami , M  
143 Mabuchi , I Giavarasteau , A Kikuta , A &ohstusuka . *Acta Med. Okayama* 1998. 52 p. .

144 [Dr YurangaWeerakkody and Dr Donna D'Souza et AL Celiac Axis and Common Hepatic Artery Variations in 5002 Patients]  
145 *Dr Yuranga Weerakkody and Dr Donna D'Souza et AL Celiac Axis and Common Hepatic Artery Variations in*  
146 *5002 Patients*,

147 [Reuter and Redman ()] *Gastrointestinal angiography*. 2ndEd. Philadelphia, WB Saunders, S R Reuter , H C  
148 Redman . 1977. p. .

149 [Standring ()] *Gray's Anatomy. The Anatomical Basis of Clinical Practice*, 39 th ed. Philadelphia, S Standring .  
150 2005. Elsevier ChurchillLivingstone.

151 [Krishna Raja Nagar Chandra Char and Shetty] Jyothi Krishna Raja Nagar Chandra Char , Shailaja Shetty .  
152 year :2012. month:sep, 6 p. .

153 [Petrella et al. ()] 'Origin of inferior phrenic arteries in the coeliac trunk'. S Petrella , C F Rodrigues , G J M  
154 Fernandez , S Marques , J R & Prates . *Int. J. Morphology* 2006. 24 (2) p. .

155 [Text book of Surgical Anatomy Holinshed] *Text book of Surgical Anatomy Holinshed*,

156 [Michels ()] 'The blood supply and the anatomy of the upper abdominal organs with a descriptive atlas'. N A  
157 Michels . *Philadelphia: Lippincott* 1955.

158 [Tandler ()] 'Über die Varietaten der arteriaceliaca und derenentwicklung'. J Tandler . *Anat. Hft* 1904. 25 p. .

159 [Variations in the Branching Pattern of the Coeliac Trunk-Case report] *Variations in the Branching Pattern of*  
160 *the Coeliac Trunk-Case report*,